Modelling of two-stage WWT systems: a faster road towards resource recovery

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Where to direct modeling efforts for a faster road towards resource recovery?

Expert presentations, a modeling Technology Readiness Level scale and the participants' own knowledge and background will provide the input for inspiring discussions, at the end of the day providing a roadmap for efficiently attributed modeling effort for two-stage resource recovery technologies.

Expected discussions and results

To allow sufficiently in-depth discussions, the scope of the workshop will be limited to so-called two-stage resource recovery systems (although they usually consist of three important steps), i.e. a pretreatment or concentration step, a post-treatment or polishing (possibly nutrient recovering) step and a concentrate processing or valorization step. The specific goals and expected outcomes of this workshop are formulated as follows:

a. Provide wastewater treatment modelers and model users with an overview of the two-stage technologies that are currently available, with a focus on the extent to which the modeling community is able to describe these technologies. This will lead to an improved knowledge and awareness amongst participants with regard to two-stage technology modeling.

b. Have an open discussion about what processes within the two-stage scheme should receive more or more efficiently attributed attention with regard to model development and the application of those models.

c. Arrive at a roadmap-like conclusion, indicating what process models to focus on to obtain fast and efficient implementation of the appropriate two-stage technologies. This roadmap will still include a range of possible unit processes and models, but will clearly indicate where to direct most efforts to fasten a wider application.

The outcomes of the workshop will be communicated to the Conference audience in the form of a 'classic' two-stage layout figure, with an indication of the processes deemed most relevant and a mention of their main modeling bottlenecks. This figure will also form the basis for a short opinion paper, communicating the workshop outcomes (specifically the envisioned roadmap) to a broader audience outside of the Conference.

Workshop set-up

To arrive at the abovementioned goals, this workshop will make use of several tools:

a. Presentation (10-20min): For every unit step in the two-stage systems, experts in the field will present both established and novel technologies and their modelwise approach, including case studies from their own field. The information provided during these presentations will make sure that all workshop attendants are aware of recent developments and provide a basis for discussion. To avoid a biased view, presentations will include a broad range of relevant technologies.

b. Discussion (25-70min): After every presentation, a discussion session will follow, where attendants are asked to use their own knowledge and background to comment on what was

presented and start moving towards a consensus concerning future modeling focus. Both the speaker(s) and the workshop chairs will lead these discussions.

c. Graphical representation: For every presented technology, a figure as shown below and very comparable to the concept of Technology Readiness Levels (TRLs) will offer an easy means of evaluating a technology both on technological and on modeling level. The premise of this figure is that progress on either scale is slow in an early stage, but can make big leaps when the unit process catches on. Upscaling the unit process and development of model-based control strategies slows down the whole process towards a 'perfect' implementation. It is clear that the scientific community as a whole should put effort in each type of technology, whatever the level. The goal of this workshop however, is to put forward some of the relevant unit processes where the invested effort is felt to be most efficiently allocated, not only on an academic, but also on an applied level. This scale can help identify these processes throughout the workshop.

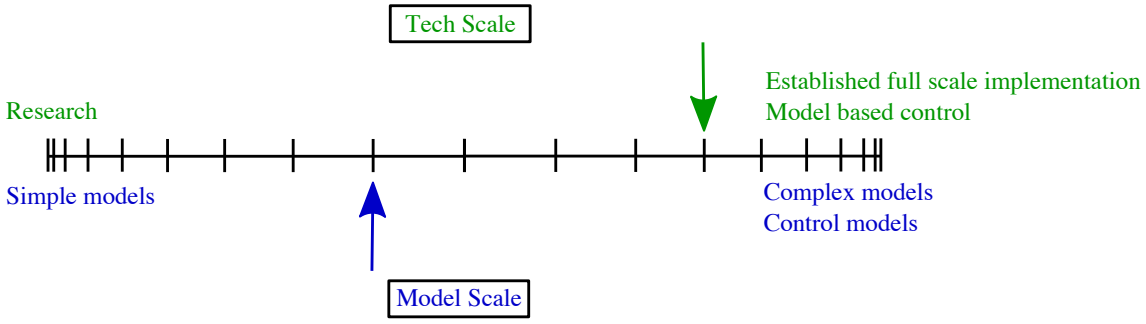

Figure 1: Graphical representation of the technological and modeling scales on which the presented technologies will be placed. In this example figure, the process in question is quite ready for application on larger scales. The available models however, cannot yet be used to support this implementation in for example design.

Chair/Co-chair

Chaïm De Mulder (BIOMATH, Ghent University, Belgium)
Mark Miller (Hampton Roads Sanitation District, Virginia, USA)

Speakers / Moderators

1 Sophie Balemans (BIOMATH, Ghent University, Belgium)
2 Jose Jimenez (Brown and Caldwell, USA)
3 Tanush Wadhawan (Dynamita, USA)
4 Borja Valverde-Pérez (Urban Water Engineering, DTU, Denmark)
5 Jean-Philippe Steyer (INRA, France)
Each speaker will join the workshop chair and co-chair in moderating his respective discussion session.

Target Participants

The way this workshop is organized allows for a lot of free interaction that promotes the transfer of thoughts and knowledge. This will especially improve the knowledge transfer between academics and people from industries and utilities. More specifically, target audiences include the following:

- Academics working in any of the three presented fields, as well as researchers interested in the holistic modeling of water resource recovery facilities.

- People from utilities and industries that have an incentive for implementation of any of the two-stage unit processes and feel they can add direction to the discussion by stating their issues or suggestions regarding to process models.
- People from utilities and industries that want to innovate by implementing two-stage unit processes, but feel there is a lacking knowledge base for their implementation and/or control.

Programme

Time	Topic	Presenter/Moderator
09:45 - 09:50	**Introduction:** Motivation, scope & objectives; Present workshop structure, presenters etc.	Chaïm De Mulder
09:50 - 10:00	**Presentation #1:** General introduction to two-stage systems	Sophie Balemans
10:00 - 10:20	**Presentation #2:** Concentration stage processes and models	Jose Jimenez & Tanush Wadhawan
10:20 10:45	**Discussion session #1**	Chaïm De Mulder, Mark Miller, Jose Jimenez & Tanush Wadhawan
10:45 - 11:15	Coffee break	
11:15 - 11:25	**Presentation #3:** Nutrient polishing and recovery stage processes and models: physico-chemical	Borja Valverde-Pérez
11:25 - 12:00	**Discussion session #2**	Chaïm De Mulder, Mark Miller & Borja Valverde-Pérez
12:00 - 12:10	**Presentation #4:** Nutrient polishing and recovery stage processes and models: biological	Borja Valverde-Pérez
12:10 - 12:45	**Discussion session #3**	Chaïm De Mulder, Mark Miller & Borja Valverde-Pérez
12:45 - 13:45	Lunch break	
13:45 - 14:05	**Presentation #5:** Valorization stage processes and models	Jean-Philippe Steyer
14:05 - 15:15	**Discussion session #4**	Chaïm De Mulder, Mark Miller & Jean-Philippe Steyer
15:15 - 15:45	Coffee break	
15:30 - 16:30	**Plenum discussion:** Wrap-up discussion, also emphasizing holistic modeling.	Chaïm De Mulder & Mark Miller
16:45 - 17:15	Wrap-up, composing summary, report and presentation	Chaïm De Mulder & Mark Miller